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AUTHOR Horgan, Noriko Saito; Hayes, Mabel
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ABSTRACT

This study explored the extent of measurable differences in performance on Piagetian tasks among six year olds who are exposed to one or two languages. Subjects (N=120) were divided into four groups: (1) native English-speaking Anglo-Americans who live in the United States; (2) native Japanese-speaking Japanese who live in Japan; (3) native English-speaking Anglo-Americans who are exposed to Japanese and live in Japan; and (4) native Japanese speaking Japanese who are exposed to English and live in the United States. Nine null hypotheses were formulated to test for significant differences among the groups on the performance of three different Piagetian tasks which were individually administered. The F-test ($p<.01$), Q-test ($p<.05$), and t-test ($p<.01$) were used for underlying distribution of the test statistics. All subjects (Japanese and American) exposed to two languages performed significantly better on the three Piagetian tasks as compared to subjects exposed to one language. There were no significant differences in performance on the three Piagetian tasks between: (1) Japanese with one language/one culture and Anglo-Americans with one language; and (2) Japanese with two languages/two cultures and Anglo-Americans with two languages. Two tables are included. (Contains 68 references.) (Author)

A COMPARISON OF PERFORMANCE ON PIAGETIAN TASKS AMONG JAPANESE AND ANGLO-AMERICAN CHILDREN SIX YEARS OF AGE WHO WERE EXPOSED TO ONE LANGUAGE AND TWO LANGUAGES

Dr. Noriko Saito Horgan
California State University at Los Angeles

Dr. Mabel Hayes
University of Southern California

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All subjects (Japanese and American) exposed to two languages performed significantly better on the three Piagetian tasks as compared to subjects exposed to one language. There were no significant differences in performance on the three Piagetian tasks between: 1) Japanese with one language/one culture and Anglo-Americans with one language; and 2) Japanese with two languages/two cultures and Anglo-Americans with two languages.

When is the appropriate time to introduce English? How should English be taught, and at what age? These and other questions are given new importance with the continuing influx into the public schools of children who speak a language other than English. One major issue revolves around the proper time to introduce the second language in the classroom. A number of studies support the conclusion that children five years of age and younger have few difficulties in learning a second language (Leopold, 1978; Yoshida, 1978). Lambert and Tucker (1972) have also suggested that increased exposure to a second language may facilitate competence in the native language among young children. Vygotsky (1962) stated that bilingual children have a cognitive advantage because of their rich and unique experience acquired by interacting with the world through two linguistic systems.

In California, for instance, the State Department of Education supports preschool in locations with a high enrollment of non-English-speaking children. A prime function of these centers was to provide programs in which English could be acquired in natural linguistic settings. In such environments children became proficient in both their native language and in English (Dahl, 1976; Wetzstein, 1978). Yet the state legislature has since mandated first-language teaching in public pre-schools and elementary schools until children are able to pass a proficiency test in their first language. (Dolson, 1991). This testing requires facility with reading and cannot even be administered until second to third grade. Little effort is being made to assist young children in becoming proficient in two languages. Rather, for the most part California bilingual education has become subtractive, substituting English for the first language.

Educational decisions about the appropriate time to introduce training in a second

language are frequently based on the results of standardized achievement tests rather than on developmental tests which may be more closely related to language development. However little research has been conducted comparing younger children (five to six years old) who speak one or two languages. This study focused on the relationship between the language or languages spoken by six year olds and their cognitive development as measured by Piagetian tasks. It was expected that the study, which concerns itself with additive bilingual education[1], would contribute to the resolution of controversial issues surrounding second language learning.

If exposure to two languages provides a cognitive advantage (Evans, 1953; Peal & Lambert, 1962; Fradd, 1982; McInnes, 1986; Aikman, 1992), this phenomenon should be measurable by conservation and classification performance as defined by Piaget (1976b). This delineation of Piagetian stages is best seen in the six-year-old child, during the transition from the pre-operational stage to the concrete operational stage (Pulaski, 1980), thereby providing a basis for a relatively clear measurement of the task of ascertaining any cognitive advantage which may be derived from exposure to two languages.

Statement of the Problem

This study examines the extent of measurable differences in performance on Piagetian conservation and classification tasks between six-year-olds exposed to one language and six-year-olds exposed to two languages. Specifically, four groups of children with the following characteristics were studied:

[1] Additive bilingualism refers to situations where both languages are supported and develop in parallel according to Diaz and Klingler (1992).

1. Japanese-born children who speak only Japanese, living in Japan (JL1).

2. Japanese-born children who speak Japanese and are learning English, living in the United States (JL2).

3. American-born Anglo children who speak only English, living in the United States (AL1).

4. American-born Anglo children who speak English and are learning Japanese, living in Japan (AL2).

Theoretical Background of the Problem

Studies built on the developmental theory of Jean Piaget have suggested that major progress in various aspects of language development occurs during the transitional stage between pre-operational and concrete operational thought (Francis, 1972; Sinclair, 1992). Language, as viewed by Piaget, is an instrument of thought organization. He stated:

> Language is not enough to explain thought, because the structures that characterize thought have their roots in action and in sensorimotor mechanisms that are deeper than linguistics. It is also evident that the more the structures of thought are refined, the more language is necessary for the achievement of this elaboration. (Piaget, 1968, p.89)

Piaget theorized that the developmental sequence through which a child progresses is universal, but that the age at which a child goes through the various stages may be dependent on the child's environmental background (Piaget, 1976b; Sigel, 1968; Piaget & Garcia, 1989).

Early studies indicated that children in industrialized societies such as Japan (Iritani, 1967), Iran (Mohseni, 1976), Canada (Dodwell, 1961), England (Lovell & Ogilvie, 1960), and

the United States (Elkind, 1961a, 1961b) progress through the Piagetian developmental sequence at a similar age, whereas children in industrially undeveloped regions may progress at a later age (Otaala, 1973; Piaget, 1976b; Sigel, 1968). Some children, in fact, never reach the formal operational stage (Bruner, 1973; Otaala, 1973; Piaget, 1976b; Sigel, 1968). Other studies have indicated that an urban or rural environment may affect cognitive development (Greenfield, 1966) and that socioeconomic status may affect the rates of cognitive development (Beilin, 1992). However, how knowledge is acquired depends on the subject's cognitive mechanism, not the social group's contribution.

Two Language Exposure and Cognitive Development

Various researchers attempted to test the effect of exposure to two languages on intellectual functioning and reported different, often contradictory, results (Liedtke & Nelson, 1965). Peal and Lambert (1962) also felt that the contradictory results were produced by little control in the studies over internal and external validity factors such as socioeconomic status, sex, educational background, and age. In their own carefully controlled study, Peal and Lambert (1962) tested the hypothesis of no difference in intellectual development between children exposed to one language and children exposed to two languages, as measured by performance on standardized tests. They found that subjects with two languages (French and English) scored significantly higher on all verbal and nonverbal tests, and concluded that the bilingual subjects developed more independent abilities and skills and possessed a more diversified and flexible structure of intellect due to their exposure to and experiences of the second language. Jacobs and Pierce (1966) also found that bilingual children scored significantly higher on divergent thinking tests than children who were not

bilingual.

Smith (1992) maintains that bilingual children develop language sensitivity at an early age, and are able to make observations and jokes about the words and the structure of the languages they possess. Bialystok also indicated that bilingual children have a stronger grasp of these metalinguistic skills than monolingual children. Metalinguistic aptitude involves the ability to approach and solve certain types of problems successfully (Cummins, 1992). The contention that bilingualism facilitates certain types of language awareness is also supported by numerous other studies (Ben-Zeev, 1977; Bialystok, 1988; Galambos and Hakuta, 1988).

Many studies in this area have used standardized tests which have been criticized by Brody and Brody (1992). Often intelligence is defined as a factor called "G", which is nothing more than a statistically derived construct. Intelligence Quotient tests do not test intellectual operation, but only test intellectual level (Brody & Brody, 1992). For example, wrong answers to questions on standardized tests give no information about the child's cognitive maturity and process. Johnson (1992) suggested that Piaget's theories may provide a more accurate assessment of intellectual capacities.

Liedtke and Nelson (1966) used conservation tasks to assess intellectual capacities and to determine whether learning a second language at an early age has beneficial or detrimental effects on cognitive functioning among Canadian children. They concluded that the mean performance for children who speak two languages (French and English) is significantly higher than the mean performance for children who speak one language. Dahl's (1976) longitudinal study, using conservation tasks, revealed that the ability to speak two languages

(English and Spanish) may accelerate the development of transitional mechanisms between the pre-operational and concrete stages. Testing with classification and conservation tasks, Diaz found bilingual children to be stronger in the area of analogical reasoning as well as in general cognitive development (Diaz & Klingler, 1992). Wetzstein (1978), using classification tasks as a measure of intellectual development in Mexican-American children who speak one and two languages, concluded that dual language acquisition (Spanish and English) may have accelerated the conceptualization of representation in classification tasks.

In conclusion, many of the studies which utilized Piagetian tasks as a measure of intellectual development in comparing children who speak two languages to children who speak one language, showed that a cognitive advantage is derived from second-language acquisition.

METHOD

Selection of Sample

The curriculum in Japanese primary schools is similar to the curriculum in American primary schools, except that Japanese schools provide moral education. Japanese and American subjects were selected carefully to insure that each had attended a preschool or kindergarten. The subjects were all selected from families which were characterized as middle class according to Hollingshead's 4-Factor Index of Social Status (1975); typically, the child had one parent who was either a professional or an owner or manager of a large business.

Japanese Population

Japanese children exposed to one language (JL1) were randomly selected from the first

grade of two elementary schools near Tokyo, Japan. The two schools each had approximately 600 students (first through sixth grade), with about 60 students in the first grade. Japanese children exposed to two languages (JL2) were randomly selected in the United States from the first grade of two elementary schools near Los Angeles. One of the schools had approximately 700 students (kindergarten through sixth grade), with about 60 students in the first grade. The other school had approximately 300 students (kindergarten through sixth grade), with about 35 students in the first grade. Japanese students living in the United States spent a significant amount of time each day in Japanese school and lived in areas which were primarily Japanese with Japanese culture predominating.

American Population

American Anglo children exposed to one language (AL1) were randomly selected from the first grade of two elementary schools near Los Angeles, California. The two schools each had approximately 500 students (kindergarten through sixth grade), with about 50 students in the first grade.

American Anglo children exposed to two languages (AL2) were randomly selected from the first grade of two elementary schools near Tokyo, Japan. One of the schools had approximately 200 students (kindergarten through sixth grade), with about 25 students in the first grade. The other school had approximately 600 students (kindergarten through sixth grade), with about 50 students in the first grade. Both were American schools for military and government dependents. The children lived on American military bases and in diplomatic enclaves where American culture predominated.

Sample

From the school populations of both countries, 120 first-grade subjects were selected. The four subject groups are:

Descriptions of Sample

	JL1	JL2	AL1	AL2
Number of Subjects	30	30	30	30
Mean Age (years)	6.9	6.6	6.6	6.6
School Location	Japan	USA	USA	Japan

Experimental Control

Experimental control was achieved by reviewing the subjects' school records and using independent observations to ascertain the following:

1. Subjects were randomly selected from the middle class.
2. Subjects had attended kindergarten.
3. Within the four groups, 15 girls and 15 boys were equally distributed.
4. The subjects were six years old and were attending first grade.
5. Ethnic and cultural differences were minimized within each group (all Japanese-born children were Japanese, and all American-born children were Anglo-American).
6. Linguistic environments were similar for JL2 and AL2: subjects had been learning a second language at school for more than one year and were temporarily living with their parents in their respective host countries but not exposed to the host culture to any great degree.
7. The parents' educational levels were similar: each of the subjects had at least one

parent with a college degree and the other parent had at least a high school diploma.

8. All subjects were selected from the middle class socioeconomic level, as defined by Hollingshead (1975).

9. All subjects in the two language groups were in an additive second-language-learning program.

Criterion Measures

If a cognitive advantage is derived from exposing two languages this fact should be measurable by children's performance of Piagetian conservation tasks. Since classification and conservation parallel each other (Sigel & Hopper, 1968; Piaget & Garcia, 1991), performance on classification tasks should be a measure of conservation performance as well. The feasibility of using Piaget's approach in the study of children who are exposed to two languages has been established previously (Kessler, 1971; Tremaine, 1975; Duncan & DeAvila, 1979).

Reliability of Criterion Measures

There is a major difficulty in using the results from Piagetian-type tests because there is not a workable statistical basis for estimating the reliability of scores. Furthermore, there are no standardized procedures to guide the researcher in the selection of administration or scoring (Beard, 1969). Piaget (1976b) was aware of these issues, and employed a clinical method because he felt that standardizing procedures prevent the understanding of the child's problem-solving process (Sigel & Hopper, 1968). Piaget's method was applied in the present study (Piaget & Garcia, 1991).

Validity of Stages

Some claim that Piagetian tests contain cultural bias (Ashton, 1978). However, Miller-Jones points out that Piaget's theory was acultural and was meant to apply to all children (Bracey, 1989; Youniss & Damon, 1992; Beilin, 1992). Many validation studies of Piaget's work have been carried out in Western countries, especially in Canada, Britain, and the United States (Almy, 1970; Dodwell, 1961; Elkind, 1961; Lovell & Ogilvie, 1960) and are being conducted increasingly in non-Western countries in Africa and Asia (Iritani, 1967; Otaala, 1973). These studies have addressed the question of whether the stages of development in Swiss children (as studied by Piaget) are similar in other populations. In general, these replication studies have supported Piaget's findings on the sequence of development of the stages. One basic Piagetian contention is that in any one developmental stage, parallel invariant sequences exist for classification and conservation (Sigel & Hopper, 1968; Piaget & Garcia, 1991).

Validity of Fixed Age

Some cross-cultural studies have shown that the fixed age for each Piagetian stage varies depending on different cultural experience (Bruner, 1973; Goodnow, 1969; Greenfield, 1966; Mead, 1966; Price-Williams, 1961) and socioeconomic class (Almy et al., 1966; Mohseni, 1976). For example, children from a higher socioeconomic class or from an industrialized society exhibit age patterns similar to Piaget's subjects in Geneva, whereas children from nonindustrialized countries develop at later ages, although in the identical sequence. The studies cited illustrate that, despite variation in methodology and in the cultural settings of children, there is considerable consistency in findings that support certain features of Piaget's theory. Piaget (1969, 1976a, 1992; Piaget & Garcia, 1991) did

acknowledge the significance of environment as a stimulant in determining the age at which different children reach the stages.

Piagetian Tasks

The three Piagetian tasks used in this study relate to Classification, Conservation of Mass and Conservation of Area. The tasks and the scoring method are described as follows:

Classification

The purpose of the first task was to discover what stage a child is in with respect to classification. The task has two parts. The first is spontaneous classification, which may result in the formation of graphic collections (Stage I), nongraphic collections (Stage II), and collections based on hierarchical systems of inclusion (Stage III). The second part contains a series of questions to discover whether the child is able to coordinate extension, in other words to define the members of a given class, and to coordinate intension, that is to define properties common to all members of that class (Piaget & Inhelder, 1964).

In this experiment, 20 colored pictures were used: 4 pictures represented assorted colored objects (a cluster of cherries, a chair, a dog, and a bicycle), and 16 pictures represented flowers; 8 of the flowers were roses (4 red), and the other 8 flowers were of different colors. The subject was asked to group pictures "that go together", and after completing this task, was asked to explain the basis for the groupings. The experimenter asked an inclusion question such as "Are there more flowers or roses?"

Scoring

Scoring was by stages and was designed to trace the continuous development, first of graphic, and then of nongraphic collections which finally lead to inclusion.

Stage I

The child matches a chain of similarities found successively in time with a spatial succession of elements. The child simply juxtaposes one element to the next, and takes each step as he comes to it, forgetting what went before and not foreseeing what must follow. For example, if a collection is comprised of red roses, different colored roses, different colored flowers, and other objects, a child may put all the red roses together, then a red cherry , a red car, red flowers, and so on. Or, if a child in this stage were asked and inclusion question such as "Are there more red roses or roses?" he would answer that there are more red roses.

Stage II

The child's collections are no longer graphic, and objects are assigned to one collection or another on the basis of similarity alone. Nevertheless, several collections are simply juxtaposed instead of being used as the basis of a hierarchical class structure. For example, unlike the Stage I child, the child in Stage II may group all the red roses, all the yellow flowers (including the yellow roses), all the similar-shaped flowers, and so on. Or, a child in this stage might respond to an inclusion question such as "Are there more red roses or roses?" by attempting to count the roses, answering that there is an equal amount.

Stage III

The child can classify the elements based on the hierarchical system of inclusion, and can coordinate intension and extension. For example, the child might form separate groups comprised of all the red roses, all the different colored flowers, cherries (belonging to the group of flowers and the group of living things), a dog (belonging to living things), and a chair and a car (belonging to the group of nonliving things). The child understands the "all" and "some" relationships, such as the presence of more flowers than roses, or that there are

more roses than red roses.

Conservation of Mass

The purpose of the second task is to discover what stage a child is in with respect to conservation. The task is concerned with the conservation of mass, in this case an amount of clay, and tests the child's ability to understand that certain properties of objects remain invariant in the face of external transformation.

In this experiment, three transformations were made using clay. Equivalence was first established by forming two identical balls of clay which the subject would agree contained the same amount of clay. Then one of the two balls of clay was rolled into a sausage shape, and finally was divided into pieces. After each transformation the child was asked such questions as "Is there still the same amount?" Also, the child was asked for an explanation to determine conservation.

Scoring

Scoring was by stages and was designed to trace continuous development, first of perceptual, then of intuitive acquisitions which finally lead to conservation.

Stage I

The child's explanations are based directly on the physical attributes which can be perceived visually. For example, as soon as the child sees the ball-shaped clay changed into a long sausage shape, he believes that a long sausage shape has more clay because it is long.

Stage II

The child attempts to coordinate the influence of perceptual illusions, transforming them into true, operational relations; consequently, he vacillates from one response to another. One moment the subject may have an idea of conservation; in the next moment, he

may lose the idea if the situation is slightly changed. For example, the child may explain that a sausage shape of clay has the same amount of clay as a ball shape, but if the shape changes into a hamburger shape or is broken into pieces, he will change his mind.

Stage III

The child is consistently able to explain that the quantities of clay are conserved, and gives an explanation such as, "You did not add any," or, "If you roll it back into a ball, then it will be the same."

Conservation of Area

The purpose of the third task is to discover what stage a child is in with respect to conservation. The task is concerned with the conservation of area and tests the child's ability to understand that if two equal parts are taken from two equal wholes, remainders will also be equal, despite the rearrangement of the parts. The concept of this task is similar to that of the second task, conservation of mass.

In this experiment the child was shown two identical rectangular sheets of green cardboard and was told that they represented two farmlands. The experimenter put a tiny plastic cow on each sheet at the same time, telling the child that the cow had that amount of grass to eat. Once the child recognized that the two fields were exactly the same, he was told that one of the farmers had decided to build a house on his farm. The experimenter then put a wooden block on one of the cardboards. Fifteen wooden blocks of identical size were added one at a time to each "farm" but arranged unequally on the cardboards to give the illusion of different areas of "grass" left for the cows to eat. On one sheet the blocks were grouped together so that they touched. If, after each block addition, the child responded that

the two cows did not have the same green areas, the experimenter would gradually move the spaced houses closer together. After each rearrangement, the question was repeated.

Scoring

Scoring was by stages, and was designed to trace the c ntinuous development, first of perceptual, then of intuitive acquisitions which finally lead to conservation.

Stage I

The child's explanations are based directly on the physical attributes which can be perceived visually. The child refuses to admit that remaining areas are equal, often after the addition of the very first pair of houses. For example, the child may say, "This one has a lot of grass because the houses are together, and this one has a little grass because the houses are spread out".

Stage II

The child's explanations vacillate between perceptual appearances and reality. For example, the child attempts to count the blocks, or to move the houses to look the same in both fields. Or, the subject may respond up to a certain number of houses by admitting that the cows have the same green areas; but beyond that number, the perceptual configurations may appear too different for the subject to believe that they are equal in area.

Stage III

The child is able to explain immediately, or almost immediately, and consistently that the remaining fields are equal. For example, the child may say, "One side looks as though it has a larger space because you put them close together, but these houses are the same size and the same number, so both cows have the same space.

Scoring Procedure

The scoring procedure was similar to that used by Piaget (1969). The child's cognitive stage was determined by his performance on the various tasks. Each task was divided into subtasks, and each subtask was used to confirm the accuracy of scoring the child's performance on the overall task.

If a subject was classified as Stage I, he received a score of 1; if a subject was classified as Stage II, he received a score of 2; and if a subject was classified as Stage III, he received a score of 3. There was a possible score of 3 points for each of the three tasks, and a possible total score of 9.

Test Administration Procedure

All testing was conducted individually by the investigator. In all the tasks, the investigator made certain that subjects understood the vocabulary that was used for testing. The investigator noted with care the type of reasoning used by the subjects, for Piaget considered the process of reasoning to be far more important than the objective correct answer (Piaget, 1980).

The order of presentation of tasks was classification, conservation of mass, and conservation of area. It is not possible at this time to determine what the effects of the order of presentation might be; these effects can only be established when different orders have been tried. The present order for the conservation items was suggested by Almy et al.'s (1966) study, which indicated that there was no significant difference in the number of children "conserving" in the various presentations.

Research Design

The research was designed to analyze statistically the measurements of the four groups,

JL1, JL2, AL1, and AL2. The hypotheses concerning the mean differences between the groups on each task (classification, conservation of mass, and conservation of area) were tested and used as a basis for making inferences. One-way analysis of variance (ANOVA), post hoc multiple comparison (Newman-Keul method), and hypothesis testing in the two-sample case were used, as described by Hinkle, Wiersma, and Jurs (1979).

The first method, one-way analysis of variance, was used to see if there were any mean differences among the four groups (JL1, JL2, AL1, and AL2). The F test was performed as the underlying distribution.

When the first null hypothesis was rejected, a second method of analyzing post hoc multiple comparison was used (Newman-Keul method) to determine which pair of groups differed. The studentized Q-test formula was used as the underlying distribution to control the experimental error rate for the set of all possible comparisons.

The student's t test was used for the underlying distribution for hypothesis-testing in the two-sample case. Two-sample groups consisted of all American subjects (AL1 and AL2) versus all Japanese subjects (JL1 and JL2) and all one-language subjects (AL1 and JL1) versus all two-language subjects (AL2 and JL2).

RESULTS

The findings of the study for performance levels on the three Piagetian tasks (classification, conservation of mass, and conservation of area) were as follows:

ANOVA

ANOVA showed that there were significant differences among the means of all four groups ($p<.01$):

Classification	F = 8.264 (3, 116)
Conservation of Mass	F = 11.303 (3, 116)
Conservation of Area	F = 13.093 (3, 116)
All Measures	F = 16.341 (3, 116)

Post Hoc Comparison

The post hoc comparison Q value of mean scores ($p<.05$) indicates that:

1. Japanese subjects exposed to two languages performed significantly better on three Piagetian tasks than Japanese subjects exposed to one language.

	X	X
Classification	JL2 = 2.567,	JL1 = 2.000
Conservation of Mass	JL2 = 2.667,	JL1 = 2.033
Conservation of Area	JL2 = 2.767,	JL1 = 1.933
All Measures	JL2 = 8.000,	JL1 = 5.967

2. American subjects exposed to two languages performed significantly better on three Piagetian tasks than American subjects exposed to one language.

	X	X
Classification	AL2 = 2.467,	AL1 = 2.167
Conservation of Mass	AL2 = 2.833,	AL1 = 1.833
Conservation of Area	AL2 = 2.467,	AL1 = 1.900
All Measures	AL2 = 7.767,	AL1 = 5.900

3. Japanese subjects exposed to two languages performed significantly better on three

Piagetian tasks than American subjects exposed to one language.

	X	X
Classification	JL2 = 2.567,	AL1 = 2.167
Conservation of Mass	JL2 = 2.667,	AL1 = 1.833
Conservation of Area	JL2 = 2.767,	AL1 = 1.900
All Measures	JL2 = 8.000,	AL1 = 5.900

4. American subjects exposed to two languages performed significantly better on three Piagetian tasks than Japanese subjects exposed to one language.

	X	X
Classification	AL2 = 2.467,	JL1 = 2.000
Conservation of Mass	AL2 = 2.833,	JL1 = 2.033
Conservation of Area	AL2 = 2.467,	JL1 = 1.933
All Measures	AL2 = 7.767,	JL1 = 5.967

5. Japanese subjects exposed to two languages performed three Piagetian task at levels comparable to American subjects exposed to two languages.

	X	X
Classification	JL2 = 2.567,	AL2 = 2.467
Conservation of Mass	JL2 = 2.667,	AL2 = 2.833
Conservation of Area	JL2 = 2.767,	AL2 = 2.467
All Measures	JL2 = 8.000,	AL2 = 7.767

6. Japanese subjects exposed to one language performed three Piagetian tasks at levels comparable to American subjects exposed to one language.

	X	X
Classification	JL1 = 2.000,	AL1 = 2.167
Conservation of Mass	JL1 = 2.033,	AL1 = 1.833
Conservation of Area	JL1 = 1.933,	AL1 = 1.900
All Measures	JL1 = 5.967,	AL1 = 5.900

t Tests

The students' t tests revealed that the observed value of t for combined groups exceeded the critical value of t ($p<.01$). The combined group of all subjects exposed to two languages (JL2 & AL2) performed significantly better on three Piagetian tasks than the combined group of all subjects exposed to one language (JL1 & AL1).

	X	X	
Classification	JL2 & AL2 = 2.517,	JL1 & AL1 = 2.083	t = 4.822
Conservation/Mass	JL2 & AL2 = 2.683,	JL1 & AL1 = 1.933	t = 4.658
Conservation/Area	JL2 & AL2 = 2.616,	JL1 & AL1 = 1.917	t = 5.924
All Measures	JL2 & AL2 = 7.883,	JL1 & AL1 = 5.933	t = 7.014

The students' t tests revealed that the observed value of t for combined groups did not exceed the critical value of t ($p<.01$) where the combined group of American subjects performed three Piagetian tasks at levels comparable to the combined group of Japanese subjects.

	X	X	
Classification	JL1 & JL2 = 2.283,	AL1 & AL2 = 2.317	t = 0.340
Conservation/Mass	JL1 & JL2 = 2.350	AL1 & AL2 = 2.333	t = 0.105

Conservation/Area	JL1 & JL2 = 2.350,	AL1 & AL2 = 2.183	t = 1.246
All Measures	JL1 & JL2 = 6.983,	AL1 & AL2 = 6.833	t = 0.456

INTERPRETATION OF FINDINGS

As the data clearly show, the subjects having a two-language exposure possess a cognitive advantage, as indicated by their mean scores on the Piagetian tasks. A graphic interpretation is presented in Table 1.

INSERT TABLE 1.

CONCLUSION

The present study reinforces the notion that bilingual children possess a cognitive advantage over monolingual children as earlier studies have maintained (Peal & Lambert, 1962; Liedtke & Nelson, 1968; Duncan & DeAvila, 1979; Hakuta & Diaz, 1985; Diaz & Padilla, 1985; Bialystok, 1992; Cummins, 1992). However this study differs in a number of significant ways: 1) The study is the first to focus on Japanese- and English-speaking children; 2) Piagetian testing was employed rather than standardized intelligence tests or linguistic/psycholinguistic tests, and three Piagetian tasks were tested rather than one; 3) The study focuses on children in the transitional stage between pre-operational and concrete-operational thought (6 years old) rather than on children who are in the concrete stage (10 years old); 4) All children were in additive bilingual programs rather than subtractive ones; 5) the research for this study was quasi-experimental in that it approximated the conditions for a true experiment with ANOVA rather than presenting just correlation findings; 6) Four groups were compared; 7) The two-language children were studied in their host country rather than in their native country, although the environment in the host country was very similar to the

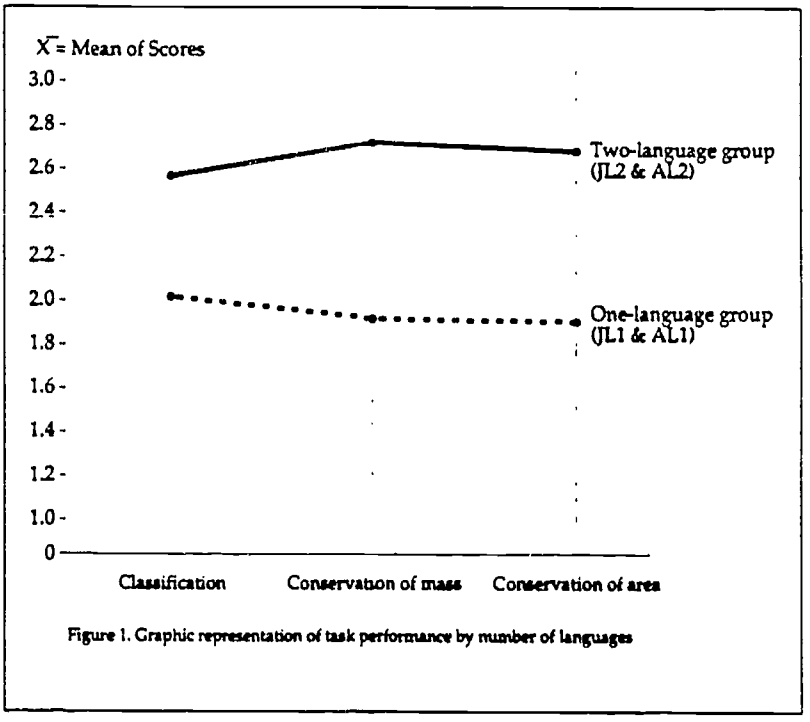

Figure 1. Graphic representation of task performance by number of languages

native environment.

One may argue that culture may be a confounding variable for this study. However Ovando (1993) stated that language is an integral part of culture from an anthropological point of view. Fuentes (1988) said that language is both a shared and sharing part of culture which cares little about formal classifications and much about vitality and connection -- that in fact, culture itself perishes in isolation.

Furthermore, it was found that children exposed to one language, whether Japanese or English, performed at comparable levels. Similar results were found in children exposed to both languages. The interpretation of the foregoing is that race (Asian or Anglo-American) and language (Japanese, English or both) are not determinants of cognitive development in children from the technologically advanced societies considered in this study. Graphic representation of these factors is presented in Table 2.

INSERT TABLE 2

Many questions remain unanswered with respect to the effect of second language introduction on cognitive development. This study addressed the effects of second language introduction on a small segment of the population. Malakoff and Hakuta (1992) mentioned that the outcome may be different when both languages are supported academically and emotionally by both the immediate community and society at large. Since both languages in this study were thus supported, the result may be confounding. Further investigation may be necessary to find some comparison of additive and subtractive bilingual education in Spanish or other languages, in other age groups, among other socio-economic classes, in situations where exposure was for more than one year, and in supportive/non-supportive environments.

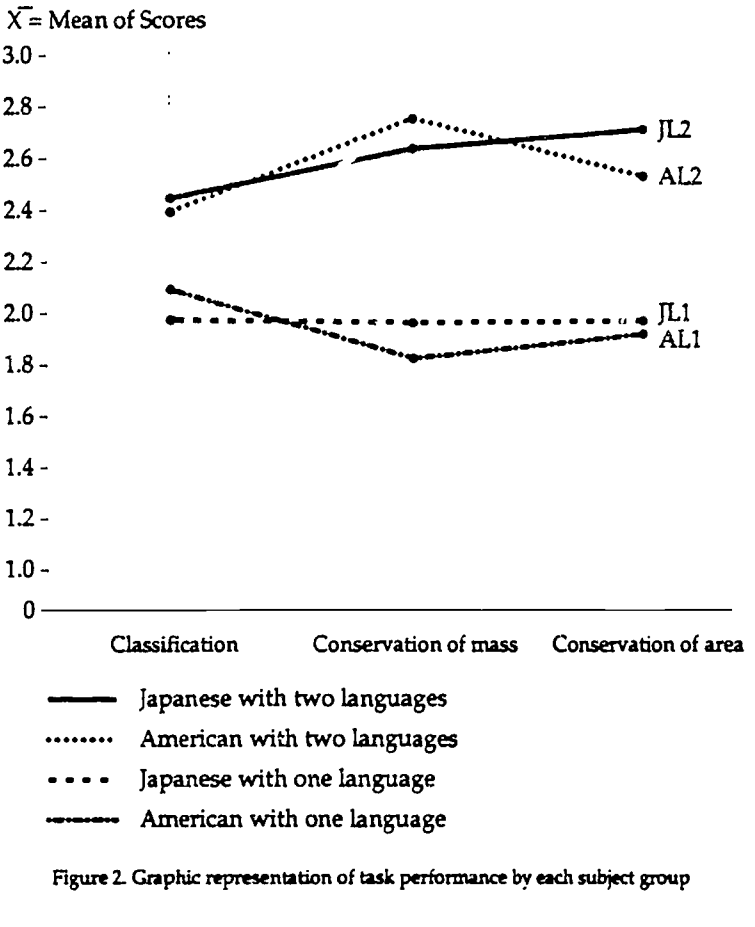

Figure 2. Graphic representation of task performance by each subject group

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